HE/5

Swimming Pools

Allen

~~D.6~~

HE/S

THE ROYAL SANITARY INSTITUTE, FOUNDED 1876.
★ SALUS GENERIS HUMANI. ★

~~136~~

THE ROYAL SOCIETY
for the Promotion
OF HEALTH
LIBRARY

Presented by

22101918485

1907.

Med
K20691

ion in the Modern Home

SANITATION
IN THE
MODERN HOME

By Jno. K. Allen, member American Society of Inspectors of Plumbing and Sanitary Engineers; Assoc. Mem. American Society of Heating and Ventilating Engineers. An invaluable guide to the architect, plumber, heating engineer and house owner, telling just what is necessary to make a house completely sanitary from sub-soil to the roof.

Five of the Eighteen Chapters appearing in this book:

Chapter IV.—What a Modern Housekeeper Wants: The porch. The vestibule. The hall. Reception room. The parlor. Living room. The library. The den. Dining room. Butler's pantry. The kitchen. The cellar. Wine closet. The laundry. The nursery. The chambers. Bath room. The garrett.

Chapter VII.—Heating by Steam. Its advantages. Types of steam house-heating boilers. Damper regulation. Pipe covering. Radiation. Window radiation. Wall radiation. Radiator valves. Radiator shields. Automatic air valves. Indirect steam heating. Floor and wall registers. Air filtering chambers. Vacuum heating systems.

Chapter VIII.—Heating by Hot Water. Its advantages. Types of house-heating hot water boilers. Draft regulators. Expansion tanks. Heat retainers and heat economizers. Special circulation fittings. Radiators. Wall and window radiators. Radiator valves. Radiator air valves. System of piping.

Chapter XIII.—Hot Water Supply. Heating water and storing it. Range boiler heaters. Automatic water heating systems. Tank heaters. Instantaneous water heaters. Hot water temperature control.

Chapter XVI.—Lighting the Home. Gas an illuminant. Individual gas plants. Proper distribution of gas. Clever and useful gas appliances. Acetylene lighting plants. Lighting by electricity. Economical devices in electric lamps. Individual electric plants.

272 pp; bound in cloth; sent prepaid for $2.00

Domestic Engineering, 49-53 N. Jefferson St., Chicago

SWIMMING POOLS

Their construction; mechanical installation; water supply; heating the water; various types of installations adapted to different conditions; with thirty illustrations and charts.

By Jno. K. Allen

Associate Member American Society of Heating and Ventilating Engineers

Member American Society of Inspectors of Plumbing and Sanitary Engineers

Editor of "Domestic Engineering"

Author of "Sanitation in the Modern Home", "A Guide to Testing Drainage, Plumbing and Gas Piping", etc.

Price 50 cents

1907
CHICAGO
DOMESTIC ENGINEERING

COPYRIGHT
DOMESTIC ENGINEERING
1907

WELLCOME INSTITUTE
LIBRARY
Coll. welMOmec
Call
No. WA

INDEX

PAGE.
Complicated plant 26-34
Construction 7
Determining grate surface required 56-57
Determining heating surface required 54-56
Determining hot water heating capacity 53-56
Determining quantity of coils 51-53
Determining quantity of heat 50-63
Determining quantity of water 48-49
Determining size of feed water heater 57-59
Heating by feed water heater 36-39
Heating by hot water 34-36
Heating by injected steam 41-45, 60-63
Heating by live or exhaust steam 46-47
Heating by special heaters 59-60
Heating by steam and hot water combined 24-26
Heating by submerged coils 39-41
Mechanical installation 19-24
Methods of heating 23-47
Overflow 41-23
Pools, location of, in buildings 6
Sanitary conditions 15-19
Swimming Pools 5-63
Types of installation 24-47
Water supply 19-21

SWIMMING POOLS

THE rapidly increasing number of public baths, athletic clubs, Young Men's Christian Associations and similar institutions in whose buildings swimming pools are constructed, emphasizes the fact that up to this time there has been little available in printed form giving data to assist the architect, engineer, steamfitter or plumber in their design or construction. A few fugitive articles describing individual installations have been published in the engineering press, but these have not attempted to give any data and but few details. Each installation seems to have been treated as an hitherto unmet condition calling for special investigation and solution and the installations have been so few in number that no one has thought it desirable to collate the data and place it in such form as to make it available for the use of others. As editor of DOMESTIC ENGINEERING I have received so many requests for information concerning various details connected with swimming baths that it has seemed desirable to treat the subject in a general and elementary manner.

The swimming bath is of comparatively recent introduction. While the British "Baths and Washhouses" act providing public facilities of that character dates back to 1846, no provision was made for swimming baths until an amendment to the act was made for that purpose in 1878.

The popularity of the swimming bath justifies its establishment. In public baths where there are swimming pools as well as other forms of baths provided, records show the pool to be utilized to a much greater degree than other baths.

LOCATION OF THE BATH.

There are, generally speaking, three conditions met with in locating swimming baths in buildings. These conditions call for the location of the pool:

(a) In the basement, the pool requiring an excavation below the level of the basement floor;

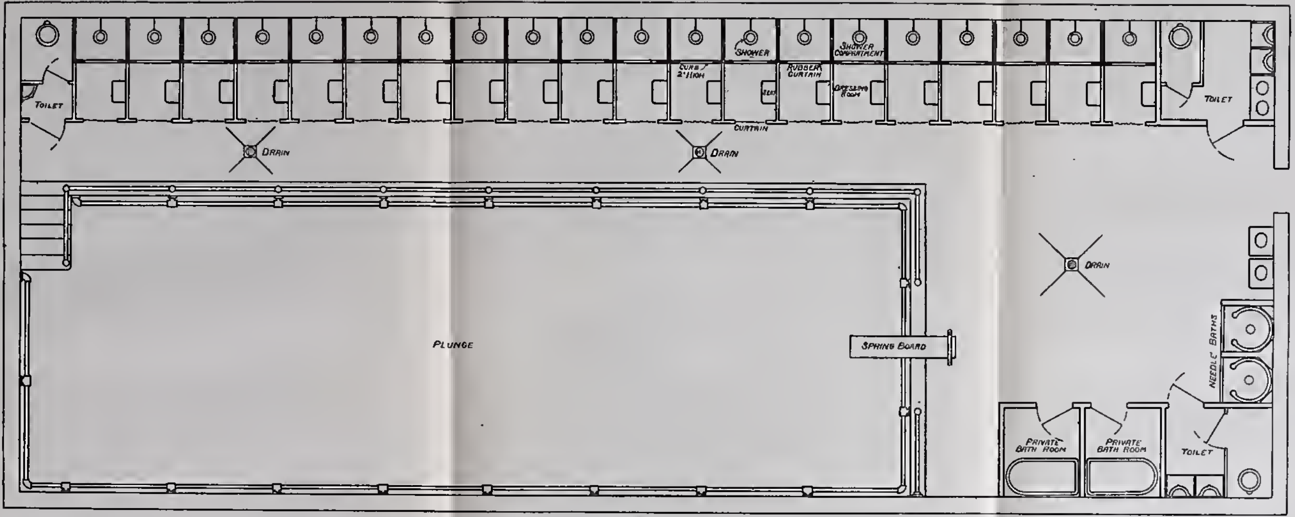

TOILET
SHOWER
SHOWER COMPARTMENT
CURB 2" HIGH
RUBBER CURTAIN
SEAT
DRESSING ROOM
TOILET
CURTAIN
DRAIN
DRAIN
DRAIN
PLUNGE
SPRING BOARD
NEEDLE BATHS
PRIVATE BATH ROOM
PRIVATE BATH ROOM
TOILET

Fig. 1.

(b) The entrance to the pool to be on a level with the first floor, in which case the bottom of the pool may be on or near the level of the basement floor; or

(c) In some floor above the basement, requiring the pool to be hung from the framework of the building.

CONSTRUCTION.

The general construction of a swimming pool is well shown in figure 1, which gives a proposed floor plan of a bath house with dressing rooms and showers, toilet rooms, needle baths, and private tub baths. Figure 2 gives a section through the pool.

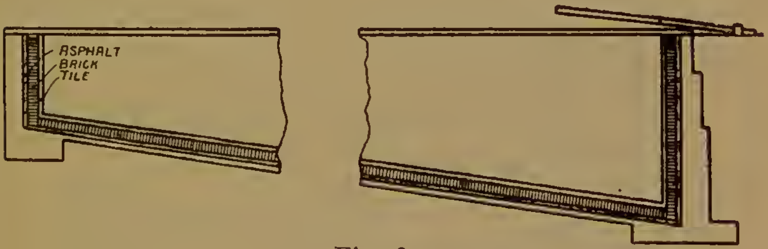


Fig. 2.

In this plan there is provided a coating of asphalt all around the pool, on the bottom and up the walls; then a layer of fireproof bricks laid in hydraulic cement; then a facing wall of enamelled bricks, tile or glass. Frequently this layer of asphalt is laid upon the walls, then a layer of burlap, then more asphalt; the finished waterproof course should be one inch thick. Anchor bolts for

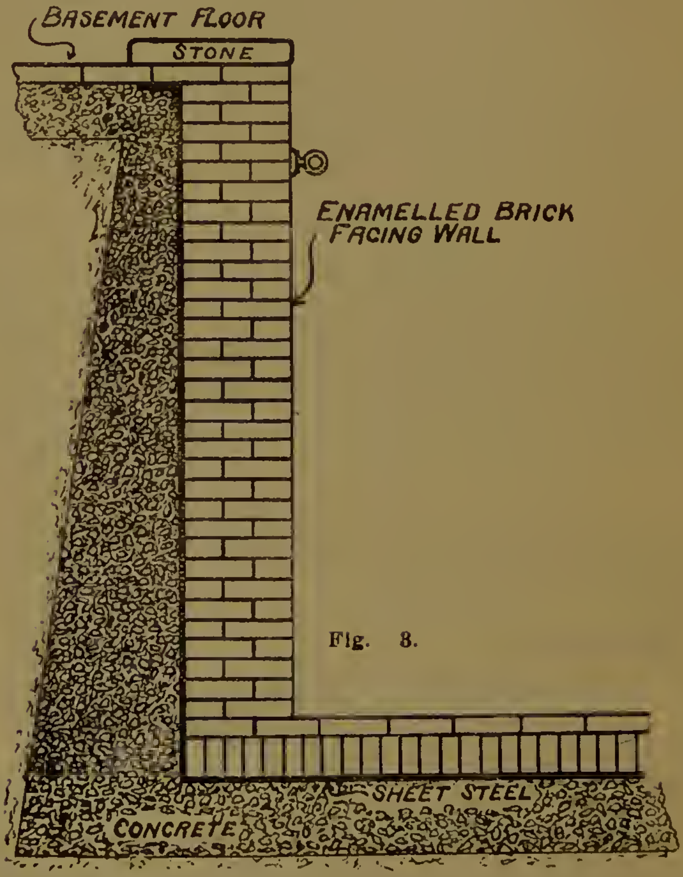


Fig. 8.

one-inch swimming rope are provided. A hand rail running all around the pool is a great convenience. This is a type of bath which does not include any unnecessary devices and cannot be cheapened much unless fewer showers should be grouped in a room by themselves. In designing a room for a pool it would enhance the cleanliness of the floor and of the pool, if entrance to the dressing rooms could be provided from a corridor at the rear of the rooms instead of from the front.

The location of the pool determines, to some extent, the type of construction to be employed, but in a general way the design will be confined within the following general lines:

A Steel Pan. Figure 3 shows a pool located below the level of the basement floor. It is built of sheet steel, either in an excavation previously made, or put together on the surface and lowered into place. The excavation should conform on its bottom to the contour of the floor of the pool giving support at all points. A concrete foundation, or brick foundation on concrete bottom may be constructed to support it. The steel pan and its framework must be strong enough to withstand the pressure of ground water when the tank is empty. When the pool is filled the pressure is equalized. The lining of the tank should be of sufficient thickness to give added rigidity to the steel pan. The top course of sheets will be flanged over to receive a coping either of marble, wood or enameled brick.

WATERPROOFING. As the excavation containing the steel pan will be backfilled and surface water will have free access to the steel, it should be first thoroughly waterproofed on its outer surface, unless a concrete course protects it. It will also be necessary to waterproof the inside before the brick or tile lining is laid in place for moisture will certainly find entrance between the steel wall and the lining, and to prevent evil results the waterproofing must be done first. If it is not done the wall may have to be taken down and rebuilt.

As the pool may have a temperature rising perhaps to 80° or more, it should be remembered that this heat will be conducted through the tile or enameled brick lining and the waterproof course should be of such a nature as not to be affected by the degree of heat to which the water is likely to be raised. There will be expansion and contraction because of this heat for which allowance has to be made. Concrete and steel contract and expand about equally.

Tile drains, laid below the level of the pool, and leading to a sump would relieve the ground of much of the surface water. The sump will quite likely be below the sewer level and an ejector pump of some form will be required to raise and discharge the surface water into the sewer.

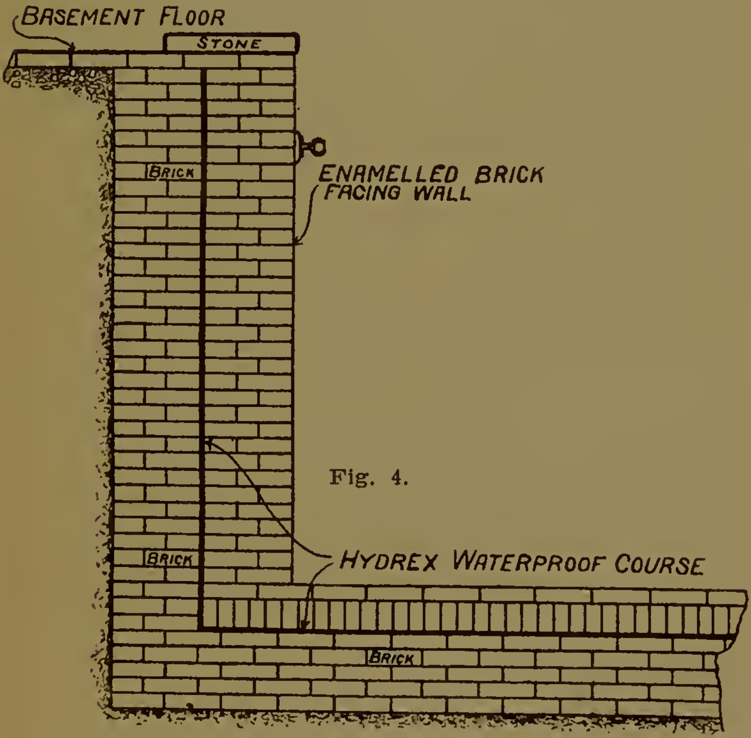


Fig. 4.

Lining. If the steel pan has a smooth surface, allowing no anchorage for the facing wall, it is important that the brick lining wall shall be of sufficient thickness to stand alone after it has been in use for some time; angles may be riveted to the steel plate for anchorage. Many expensive repairs are necessary because of building a thin facing wall. The main wall should be built of brick of good quality, laid in portland cement. Fireproof brick good for this purpose. No lime morter should be used. The foundation wall should then be faced with enameled brick laid in hydraulic cement; or the face may be covered with cement and the walls lined with tiles or glass, also laid in hydraulic cement. Marble has been successfully used in small pools.

MASONRY. Figure 4 shows a method of constructing the double walls of the pool of brick or stone, laid in portland cement, with a "Hydrex" waterproof course between the two walls. This prevents the surface water from seeping in or the contents of the pool from seeping out. The walls can be rough cast with cement and faced with enamelled brick, tiles or glass, laid in hydraulic cement.

CONCRETE. Figure 5 shows a pool constructed of concrete with a rough coat inside, on which a facing of Winslow's waterproof cement, or of Stettin cement is laid, also with a rough surface, on which the facing of enamelled brick, tiles or glass is laid in hydraulic cement. Concrete expands and contracts and expansion joints may have to be provided to prevent cracks.

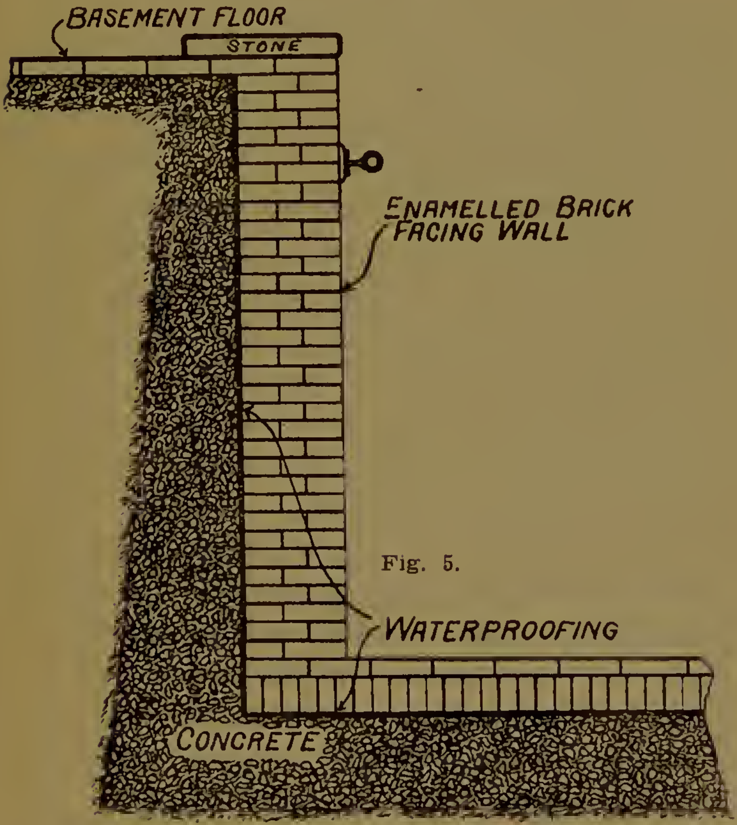


Fig. 5.

Should the pool be located in the building so that it may rest on the basement floor, the construction should be, in the case of large pools, as shown in figure 4 or 5, the waterproofing being necessary to keep the water within the tank from filtering through the walls. The steel pan as shown in figure 3 could be used if strong enough to carry its contents without the support which would be given by the backfilling if placed in an excavation.

When the swimming bath is to be on some one of the upper floors of a building the steel pan as shown in figure 3 must be used. The problems are great in cases of this kind. The increased strength required in the framework of the building in order to sustain the immense weight of the tank when filled with water is one of them. The expansion and contraction due to heat, the swaying of buildings due to wind pressure, and the vibration of buildings due to buried or elevated transportation lines, running machinery, etc., make it difficult to build a lining wall in such a tank which will permanently remain intact.

Extended experience with concrete and brick or masonry walls, will lead some to prefer steel pans, particularly below the ground. On the other hand large pools, if built of steel, are expensive. Due consideration has to be given to the character of the soil in which the pool is to be built. It is of prime importance that the pool shall be water-tight.

SANITARY CONDITIONS.

THE WATER SUPPLY must be free from organic or inorganic impurity. It should be copious enough to permit frequent, daily if possible, change of water in the pool. In one pool, beautifully clean, where the bathers average 2,250 a month, the water is changed twice a week. The frequency of change will depend on the number and character of the bathers. The water should be filtered. One has but to compare a pool containing filtered water with one filled with unfiltered water, instantly to note the difference. Unless the water supply is of exceptional purity and cleanness, the body of unfiltered water in the pool will seem like a weakened solution of ink, while the filtered water has a beautiful translucent opaline tint which is entrancingly inviting. Stringent provisions must be enforced to prevent careless fouling of the water by bathers. Spitting should be prohibited. Urinal accommodations should be provided to be invariably used by bathers before entering the pool. If possible to adopt a system of water supply and heating by which currents shall be maintained in the pool the water will be aerated and kept in better condition. Surface impurities must be removed. The pool should be frequently emptied for cleaning, and, because standing bodies of water cause slimy deposits, the walls should be of perfectly smooth, impermeable surfaces, unbroken by wall chases or pockets. No pipe coils or standing overflows should obtrude into the pool. In swimming matches obtruding objects are very objectionable. A coping, rising two inches above the room floor should prevent washings from the floor from running into the pool.

Great care should be exercised to guard against the infection of the water by persons supposedly afflicted with cutaneous, venereal, infectious or communicable diseases. Hygienic considerations require that a rigid scrutiny should be made of all bathers. Habitues of the bath should be required to show a decent regard for modest proprieties of life and for the rights of other bathers. This form of a spittoon (Fig. 6), flushed and connected with the sewer, was designed especially for swimming pools.

TEMPERATURE. The temperature of pools varies with the requirements in each case. For general swimming pools where the bathers remain in the water for long periods, the temperature should be from 70° to 75° Fahr. For cold plunges the temperature may go so low as 65°. Much lower makes too great a demand on the body's vitality. The temperature of the room should be 82° Fahr.

Fig. 6.

Lighting. A dimly lighted room invites uncleanness, and that cannot be tolerated in a swimming bath. A well lighted room asists the tonic effect, both mental and physical, which should result from a plunge. The healthful effects of sunlight have been well pointed out by Koch, who states that the tubercle bacillus is killed by the action of direct sunlight in a time varying from a few minutes to several hours, depending upon the thickness of the layer [of substance] exposed. Diffused daylight also has the same effect although a considerably longer time of exposure is required. Duclaux says that sunlight is one of the most potent and one of the cheapest agents for the destruction of pathogenic bacteria, and that its use for this purpose is to be remembered in making practical hygienic recommendations.

On this same subject M. J. Rosenau, M. D., of the Hygienic Laboratory of the United States Public Health and Marine Hospital Service, says:

"Sunlight is an active germicide. It destroys spores as well as bacteria. The importance of the sun's rays in destroying or preventing the development and growth of micro-organisms in nature cannot be overestimated. . . . Even diffused light retards the growth and development of micro-organisms, and if strong enough may finally kill them."

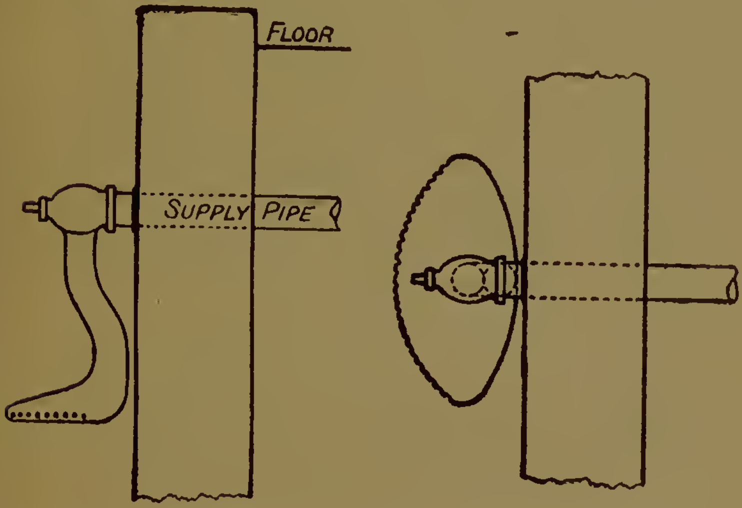
The handbook of the German Imperial Board of Health says of sunlight: "Light, which illuminates the most remote corner of a room, impels us to cleanliness and destroys many of the minute bacilli which are the causes of decomposition. putridity and disease. On the other hand, dirt and dust easily accumulate in dark rooms."

VENTILATION. The moist, humid air of a swimming bath easily becomes offensive unless frequently renewed by ventilation. To be sure the human occupancy of a swimming bath bears such a small ratio to the cubical contents of the room, that the problem of ventilation is an easy one, but the air should not be allowed to become "dead."

MECHANICAL INSTALLATION.

WATER SUPPLY. The water supply piping connected with a swimming pool is not complicated, and what there is of it is necessarily connected with the heating of the water. The piping must be designed so that water may be introduced into the pool either cold or warm. The pool may be constructed so that the water supply and the waste shall be located at the end having the greatest depth, or the waste may be at the lowest point of the pool, and the supply may be brought in at the opposite end. If more convenient, the supply may be brought in at either side and the waste may be taken out at the other side, but some consideration should be given to securing an equable circulation of the water so that there shall not be a "short circuited" current of water from the supply directly to the waste.

The lowest point in the pool should be constructed with a gutter, either pitched toward the corner, if it is more convenient to have the waste pipe taken from there, or pitched toward the center if it is desired to take the waste from that point. If more convenient the lowest point in the pool need not be at the extreme end, but may be nearer the center. The location of the waste will be determined by the construction of the heater room, in which all controlling valves should preferably be placed. It may be that the form of the building in which the pool is placed will not permit the heater room to be located at the lowest end of the pool, in which case it may be placed at either side, the waste and supply being piped into the end having the greatest depth. Flush with the bottom of the lowest point of the pool a brass strainer should be placed over the entrance to the waste pipe, preferably with a convex top, preventing the entrance of foreign matter into the waste pipe; if convex it does not permit the outlet to become covered up. The waste pipe should be large, 6″ or 8″ being ample for most pools. The waste pipe is carried downward far enough to pass under the retaining wall of the pool. It is then disposed of in accordance with one of a number of plans which will be shown later. Its general treatment is to have placed upon it a gate valve which, when open, allows the water to flow from the tank. A running trap is placed on the waste pipe with cleanouts accessible from the floor. This running trap prevents the air from the sewer from entering the pool when it is empty and it may be vented if desired.



Elevation. Plan.

Fig. 7.

THE OVERFLOW. At the proper height to retain the desired depth of water in the pool, an overflow pipe is taken off, the entrance to it being covered with a convex brass strainer. The overflow pipe should be 3″ or 4″ in diameter and should enter the waste pipe between the draining valve and the running trap. No standing waste and overflow should be permitted. The scum which collects on the surface of a used tank is not removed by an ordinary overflow. A surface spray has been designed and installed in a number of pools which is helpful in removing the surface water of the pool. It is shown in Figure 7. It is supplied with cold water, placed at the shallow end of the pool, 15 to 18 inches above the water level. When turned on it causes a gentle surface movement toward the overflow and removes the scum.

A form of gutter overflow surrounding the entire pool at the water level is shown in section in Figure 8. It is channeled from marble or can be made of copper set into the facing wall, or be made of enamelled brick. One and one-half inch wastes, guarded with brass strainers, are placed in the bottom every 15 or 20 feet, the waste pipes leading into a general 4″ waste pipe surrounding the pool or being carried individually into the main overflow pipe above the trap, as may be most convenient. This form of overflow is very efficacious in keeping the pool clean all the time, as the action of the bathers constantly agitates the surface and causes the surface water and its impurities to be removed.

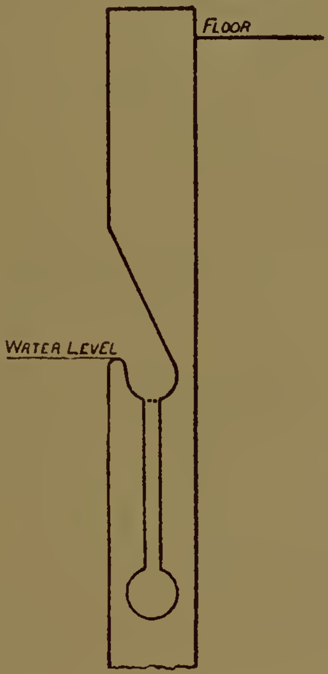


Fig. 8.

METHODS OF HEATING. Several different methods of heating the water may be used, that being adopted which is most available. If the pool is constructed in a building in which there is a high pressure steam plant, the water may be heated in one of two ways,—either by the injection of live steam into the water (either into the tank itself or preferably into a mixing pipe before the water reaches the tank) or by a feed water heater or other type of heater using live or exhaust steam as the heating medium. If no exhaust or live steam is available the water will have to be heated by some type of a hot water or steam heater. Illustrations will be given of many varieties of installations, so that the reader will find some one type of construction which will meet his problem.

TYPES OF INSTALLATION.

COMBINED STEAM AND HOT WATER HEATERS. One method of installation combines steam and hot water house heating boilers, the steam boiler being used for supplying heat for the building in winter and aiding in heating the water for the bath, and the water heater supplying the hot water for the swimming pool in summer and doing a portion of that duty in winter. This combination possesses the advantage of supplying the heat for the building and heating water for the bath, and at the same time provides a plant which it is not necessary to utilize all of the time in its entirety. In many swimming pools the patronage is variable; on some days more people bathe in eight or ten hours than come during the remainder of the week. On this account it is necessary to supply a system which will meet the maximum demand. In this combined system, as already stated, the steam heater can be used to heat the building and by means of the auxiliary water heater attached to it shown in the illustration, it can also supply all of the hot water needed except during rush hours, when the water heater can be placed in operation. Conversely, during the summer the water heater only need be put into duty unless a larger demand may require the steam heater to assist in supplying hot water. This combination is shown in figure 9,

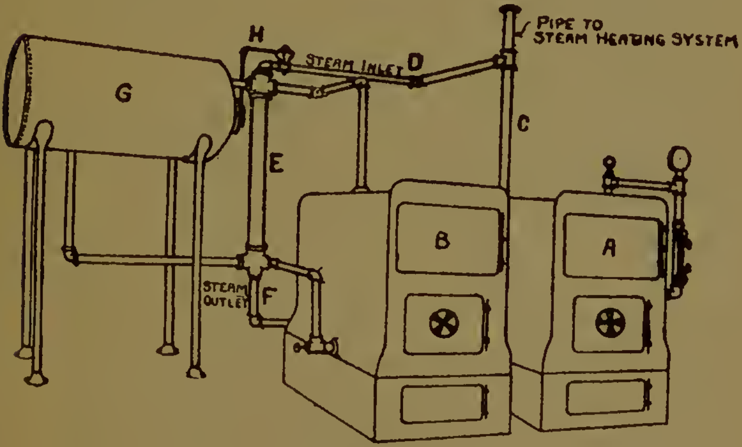


Fig. 9.

in which "A" is the steam heater and "B" the hot water heater. "C" is the pipe leading to the steam heating system of the building. "D" is the steam inlet pipe to the auxiliary hot water heater "E." "F" is the steam outlet pipe returning into the steam heater "A." "G" is the tank for storage purposes which is governed by a thermostatic valve "H" controlling temperature at any desired point. The details of the auxiliary hot water heater "E" are shown in figure 10.

A Complicated Plant. Another type of installation is shown in plan in figure 11, and in detail in following illustrations. This installation is applicable to a large apartment building, hotel, club or other structure in which the mechanical equipment is very complete. In this installation attention is paid particularly to an economic handling of the problem, so that the heating of the water is not made a matter of initial expense, but water is used in the bath which has previously been used for other purposes. The designer and the constructing engineer should always make Economics and Operation walk hand in hand. In the installation shown by these illustrations a liberal demand for water in the swimming bath promotes the efficiency of the mechanical installation and reduces, rather

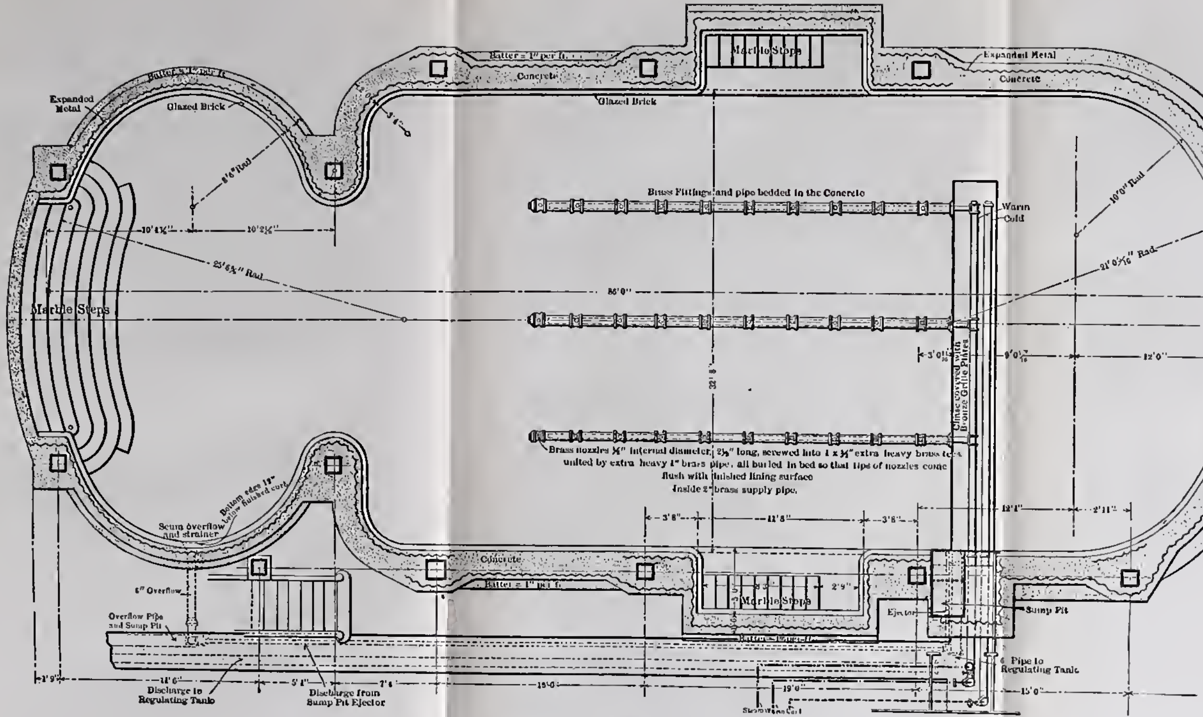

Marble Steps
Batter = 1" per ft.
Concrete
Expanded Metal
Concrete
Expanded Metal
Glazed Brick
Glazed Brick
Batter = 1" per ft.
8'6" Rad.
10'4½"
10'2½"
25'6¾" Rad.
86'0"
Marble Steps
Brass Fittings and pipe bedded in the Concrete
Warm
Cold
10'0" Rad.
21'0½" Rad.
Batter = 1" per ft.
3'0"
Climac covered with Bronze Grille Plates
9'0"
12'0"
32'8"
Brass nozzles ¾" internal diameter, 2½" long, screwed into 1 x ¾" extra heavy brass tees united by extra heavy 1" brass pipe, all buried in bed so that tips of nozzles come flush with finished lining surface
Inside 2" brass supply pipe.
Concrete
12'1"
2'11"
3'8"
12'8"
3'8"
Bottom edge 12" below finished curb
Scum overflow and strainer
Concrete
Batter = 1" per ft.
Marble Steps
2'9"
Ejector
Sump Pit
6" Overflow
Overflow Pipe and Sump Pit
6" Pipe to Regulating Tank
1'9"
11'6"
5'1"
7'4"
15'0"
19'0"
15'0"
Discharge to Regulating Tank
Discharge from Sump Pit Ejector
Steam
Cold

Fig. 11.

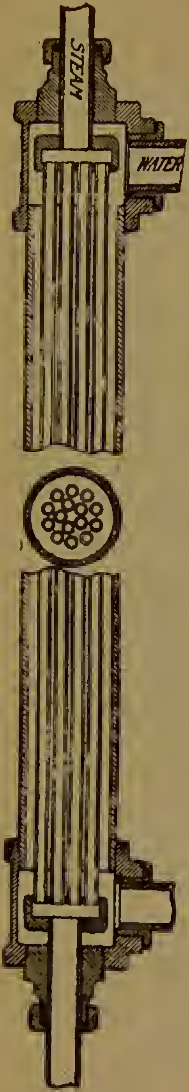


Fig. 10.

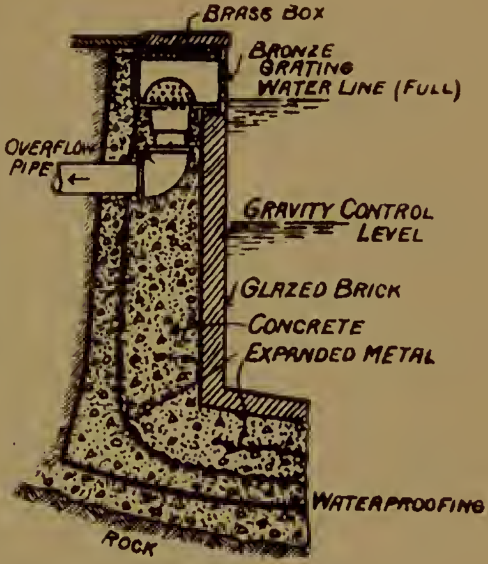


Fig. 12.

than increases, the operating expense of the establishment.*

The bath in this case is constructed of reinforced concrete walls and floor, the pool being, in the case from which the illustrations are taken, in an excavation in the solid rock. The concrete walls have an average thickness of 3 feet and are reinforced by overlapping sheets of expanded metal embedded in the concrete parallel with the surfaces. A water proofing course of several thicknesses of tarred paper and hot asphalt is laid close to the outer surface of the concrete and embedded in it, and this water proofing course is continuous over the whole exterior of the bath. The lining of the bath is of white glazed brick, laid in hydraulic cement. The bath is entered by three flights of stairs with white marble tread and riser slabs bedded in the concrete. A sump is excavated, extending below the level of the bottom of the bath, in which ground water is collected, from which it is ejected to the sewer. The concave form of the bottom of the pool was designed to resist the upward pressure from ground water when the pool is empty. In the side wall of the bath there is a vertical recess through which the inlet and outlet pipes are carried to the bottom of the bath, then extended underneath the floor of the bath. This recess is covered by a removable bronze grill of ½″ metal countersunk screwed to the rebated face of two vertical bronze jamb plates. These plates are Z shaped with horizontal inside ribs, through which hook rods anchor them back to the concrete. The bath is enclosed by a brass railing on 2½″ vertical posts which extend through the marble coping 18″ into the concrete. This pool has a dimension of 86′x33′x11′ maximum depth. Its highest water line is 9′ 9″ and it has a capacity of 23,000 cubic feet, or approximately 172,000 gallons. It requires 3½ hours to fill.

---

*These details are taken from plans of R. P. Bolton, M. E., made for "The Ansonia," in New York.

By the complicated system of piping which is possible in the complete establishment in which it is installed, this bath is supplied in any one of the following ways:

(a) With cold water directly from the street mains.
(b) With cold water heated with injected live steam.
(c) With tepid water.
(d) With hot water.
(e) With hot water superheated by steam, or
(f) Steam alone injected into the standing water at the bottom of the bath.

Its normal supply is hot or tepid water which has already been used in the refrigerating plant. All the water supplied to the bath is filtered and that which is used first for refrigerating purposes is circulated around coils, great care being taken to prevent contamination. Tepid water having a temperature of about 90 degrees is delivered through a 3″ pipe from the closed absorber of the ice plant. Hot water from 110° to 120° is delivered through a 3″ pipe from the ammonia condenser. Cold water is delivered through a 4″ pipe. Live or exhaust steam is delivered through a 1½″ pipe. All these pipes connect into a header and they are so valved that the heater may receive a single supply or a supply from two or more sources at once. A 4″ horizontal hot water pipe is carried nearly across the bath in a trench in the concrete floor covered with a removable bronze grill. This pipe is closed at its farther end. From it are taken three 2″ horizontal branches about 20′ long open at their extremities, each branch passing through a stuffing box into a 4″ brass jacket pipe, closed at both ends and bedded into concrete floor about 5″ below the finished surface. This jacket pipe serves as a shell from which the 2″ horizontal branch pipe may be removed if necessary without disturbing the floor of the bath. It also serves as a distributing chamber which is filled from the inside pipe and discharged into the bath through small vertical brass nozzles ½″ in diameter screwed into Ts set about 24″ apart on the 4″ jacket pipe, their tips being flush with the finished floor surface. There are 30 of these nozzles and through them water of any desired temperature between about 50 degrees and 120 degrees is injected into the bath, its distribution being over the middle third of the bath floor.

The 4″ cold water supply to the header is valved and continues down the wall chase and across the bath floor in the trench. It is perforated with ¼″ holes 3″ apart on the upper surface. Its farther end is closed. Except under unusual conditions the bath will be supplied with warm or tepid water only and it is intended that its temperature should be maintained at 66 degrees. The engineer who installed this plant estimated the daily supply to be required to be 60,000 gallons, and in the city in which it is installed the rate is $1.00 per 1,000 cubic feet, which would make the annual cost of this water $2,800. By utilizing the water previously used in the refrigerator plant its cost is saved plus what it would cost to heat it. Another economic use of the water is after it has been used in the bath and passes on to the overflow sump it is refiltered and used for flushing the fixtures in the toilet rooms. This seems to be very undesirable. A fixed high water overflow is built in one wall of the bath and a brass box with a vertical bronze grating in the face of the wall just below the coping of the bath. See figure 12. A removable convex strainer covers the outlet to an 8″ waste pipe which discharges to a sump, from which the water is periodically pumped into the sewer. This outlet is not ordinarily used, but a regulating pipe has been provided by the engineer which limits the height of water in the bath at a point lower than the overflow described and this height is adjustable. The regulating pipe is a 6″ iron pipe having its highest point 24″ below the high water overflow level. The regulating pipe rises from the bottom of the bath, running alongside the inlet pipe in the wall chase, thence in a floor trench to the pump sump. (See figure 13.) When the bath is filled to within two feet of its maximum depth this regulating pipe is always full of water and connects into a steel plate regulating tank, figure 14, set in the upper part of the pump sump, its upper edge being a little above high water level in the bath. The tank overflows into the sump through a vertical telescopic center standpipe, the upper part of which is controlled by a hand wheel and regulating screw. It slides through a stuffing box. The position of the upper edge of the standpipe determines the level of the water in the bath. A suction pipe runs from the lower part of the regulating tank to the pump which supplies the flushing system of the toilet rooms, and water does not overflow through the waste into the sump until the demand for water for flushing is met. All of the water in

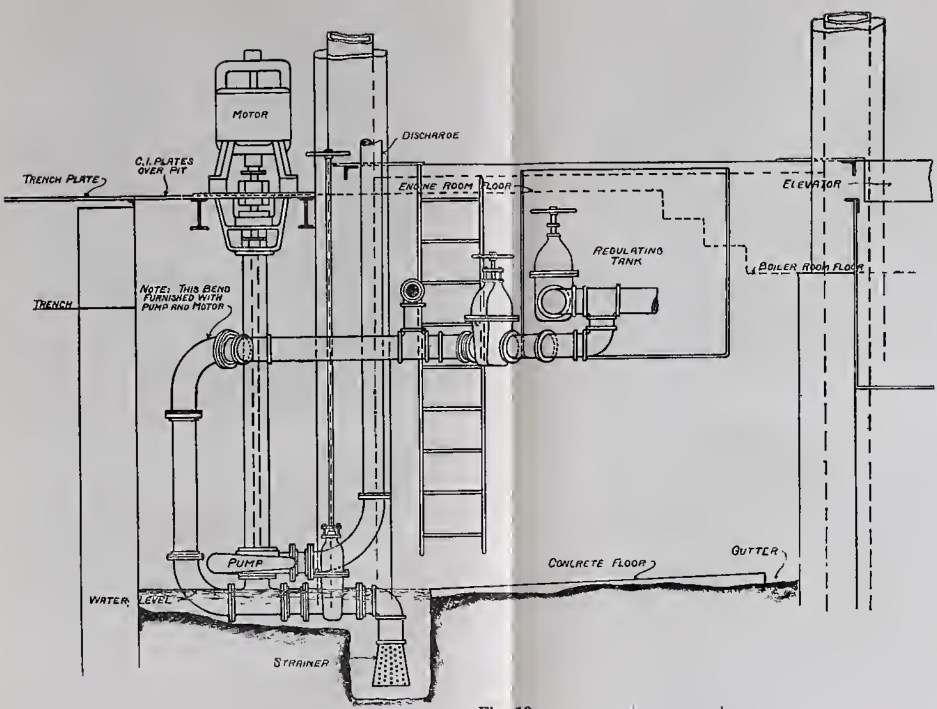

MOTOR
DISCHARGE
C.I. PLATES OVER PIT
TRENCH PLATE
ENGINE ROOM FLOOR
ELEVATOR
REGULATING TANK
BOILER ROOM FLOOR
TRENCH
NOTE: THIS BEND FURNISHED WITH PUMP AND MOTOR
PUMP
WATER LEVEL
CONCRETE FLOOR
GUTTER
STRAINER

Fig. 18.

excess of that required for the flushing system reaches the sump and is thence pumped to the sewer by a submerged centrifugal pump driven by a vertical shaft enclosed in a steel tube having its upper bearing above the water level. This pump is so arranged that it will perform several duties. In providing more than one duty for a pump great care

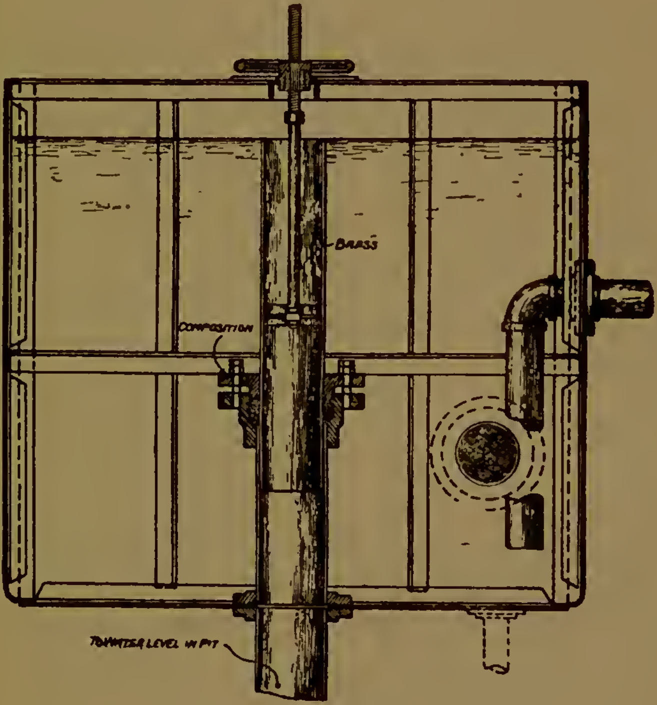


Fig. 14.

must be taken that no dangerous, careless operation by the engineer will be possible. The pump suction has two inlets; one with a strainer to receive the water from the sump, and the other connected with the regulating pipe from the bath, and to the discharge from the ejectors which deliver the kitchen and cellar drainage to the sewer. These are all valved so that the pump may serve either of the three duties, although it is usually used only for discharging the overflow water not required for flushing the toilet fixtures, and that water delivered to the sump from the ground water sump at the bath inlet by the automatic steam syphon which is installed there. The bath can be emptied in two hours by the centrifugal pump and the water discharged directly into the sewer, or circulated through a closed condenser on the exhaust connection of the elevator pump, thus rendering additional service before it is lost in the sewer. The kitchen and cellar waste and ground water are ordinarily discharged into the sewer by their own separate automatic apparatus, but connections are made to the centrifugal pump in case these apparatuses should be disabled.

USING A HOT WATER HEATER. Figure 15 shows a simple method of piping the cold water supply to a swimming pool. The supply pipe "A" should

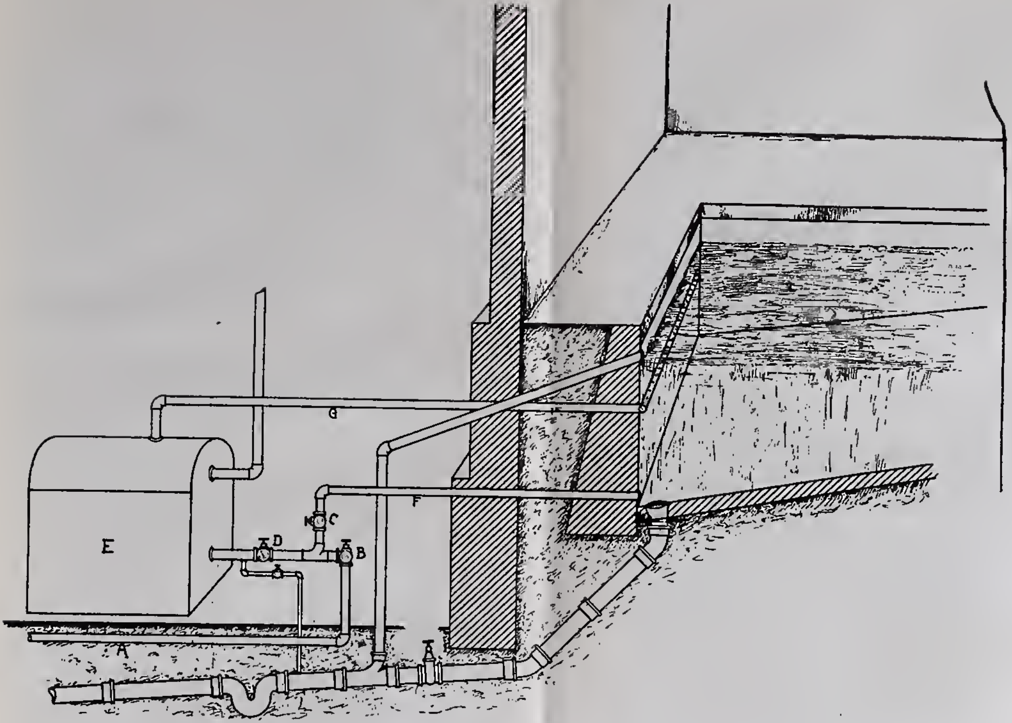


Fig. 15.

be 3″ or 4″ in diameter. It is brought up to the level of the feed pipe to the heater "E" and an angle valve "B" is placed on it. It is then fed into the bottom of the heater, a gate valve "D" being placed on it as shown. A circulation branch pipe "F" from this feed pipe "A" is taken off the same size and led into the bottom of the pool and covered with a convex brass strainer. The flow "G" from the heater "E" is also led into the pool at a higher level than the circulating pipe "F," and the supply of water to the pool may be distributed across its whole width by using a perforated discharging pipe. By this system of three valves, the water supply is under complete control. When the pool is to be filled the angle valve "B" is opened, the gate valve "D" is opened and the gate valve "C" is closed. The water passes through the heater "E" its temperature being governed by the degree which the valve is opened. The heater fills until water passes up through the flow pipe "G" and runs into the pool. The heater in the illustration shown is of the ordinary domestic hot water house heating type. The fire in the heater is then lighted and the pool fills with warm water. When filled to the level of the overflow the angle valve "B" is closed and the gate valve "C" is opened. The circulation is then from the pool through the circulating branch "F" into the heater "E," out of the flow pipe "G" into the pool. This circulation may be carried on as rapidly or as slowly as desired, the partial closing of "D" governing it completely. When the water in the pool has reached the desired temperature the fire in the heater may be checked so as to maintain it. It is plain that the temperature of the water in the pool may be raised to the desired temperature, say 65 degrees F., by continuing this circulation. The water in the pool may then be kept fresh by gradually changing it. This may be done by closing valve "C" and opening the angle valve "B" to the desired extent. The cold water supply will then pass through the heater, be warmed, and flow into the pool, and a like quantity of water will pass out through the overflow into the sewer. If desired, the valve "D" may be closed, "B" and "C" opened and the tank filled with cold water and then be heated by circulating through the heater.

HEATING WATER BY A FEED WATER HEATER. Figure 16 shows the floor plan of a pool with the location of its hot water inlet and the suction waste in opposite diagonal corners. This pool is 22′x-31′x7′ in depth. Its bottom and sides are lined with white tile finished with marble coping and the bath is approached by marble stairs. In this installation the top of the wall of the pool is on a level with the basement floor of the building, the bottom of the pool is several feet below the street sewer and also below tide water. The walls are built of brick laid in cement with a coating of cement on both sides of the brick work; the outside coating is covered with asphalt. The floor of the pool is of concrete. The pool contains about 300,000 pounds of water and must be heated to 70 degrees in four hours and the water must be renewed once each day. The water supply is heated by a feed water heater of 250 h. p. Figure 17 shows

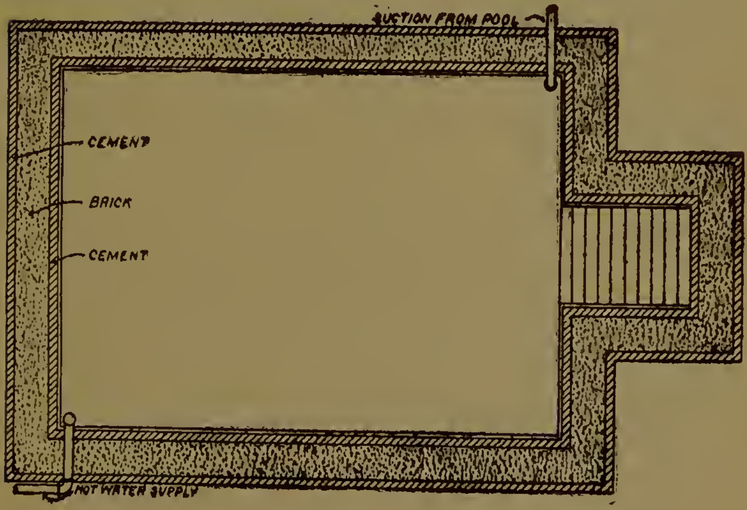


Fig. 16.

how a steam pump circulates the water from the pool through the feed water heater and empties the pool when necessary directly into the sewer. A delivery pipe from the feed water heater leads to the pool to a point about three-quarters of its depth. From a gutter at the diagonal corner of the pool a suction pipe leads to the pump. The cold water supply is brought into the feed water heater. Live steam taken directly from the boiler enters the top of the water heater and warms the water as it flows through the heater. The city pressure fills the pool with water which is warmed as it passes through the feed water heater. A gate valve controls the water supply which, when the pool is filled, is closed. If the water has not been raised to the required temperature by once passing through the feed water heater it is again passed through by the pump. When this is done the live steam supply to the feed water heater is shut off and the exhaust steam from the pump is let into the feed water heater and supplies heat to the water. A back pressure valve on the exhaust pipe prevents nearly all back pressure on the steam pump. The pump takes the water from the gutter and in carrying it through the suction pipe delivers it into the feed water heater, passing it through the heater and delivering it into the pool through the flow pipe. This

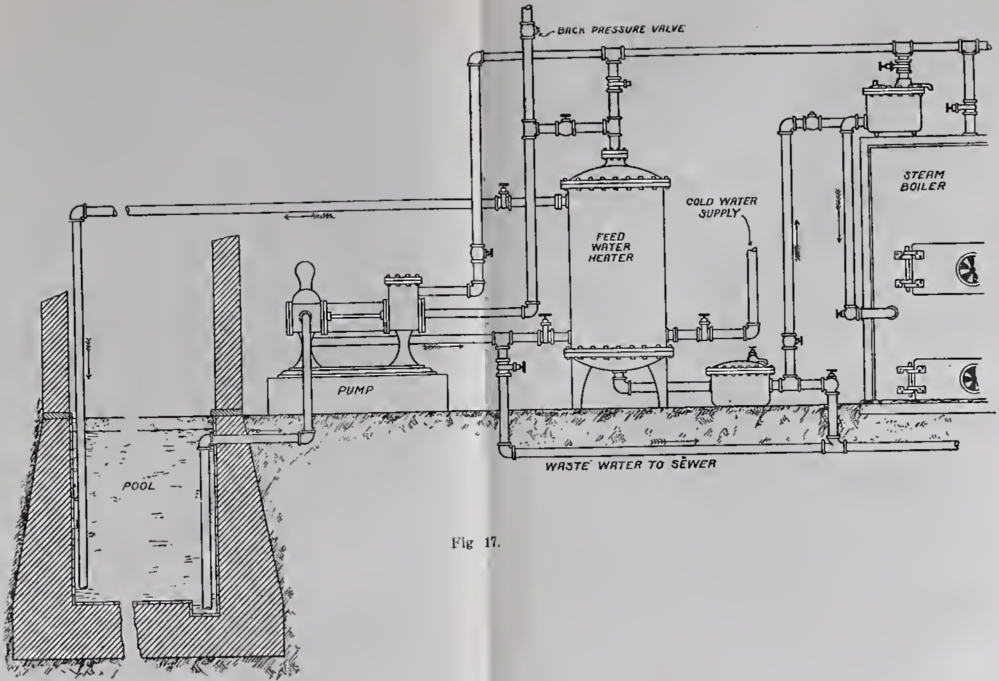

BACK PRESSURE VALVE
STEAM BOILER
COLD WATER SUPPLY
FEED WATER HEATER
PUMP
POOL
WASTE WATER TO SEWER

Fig 17.

circulates continuously until the temperature has reached the desired point; thereafter the circulation is only kept up enough to make up for the loss of temperature by radiation and evaporation. The piping is so valved that the pump can be used to discharge the contents of the pool into the sewer. The feed water heater has a grease extractor so that its condensation is used to feed the steam boiler. When the pump is emptying the pool the exhaust enters the feed water heater for the purpose of warming the water for the steam boiler.

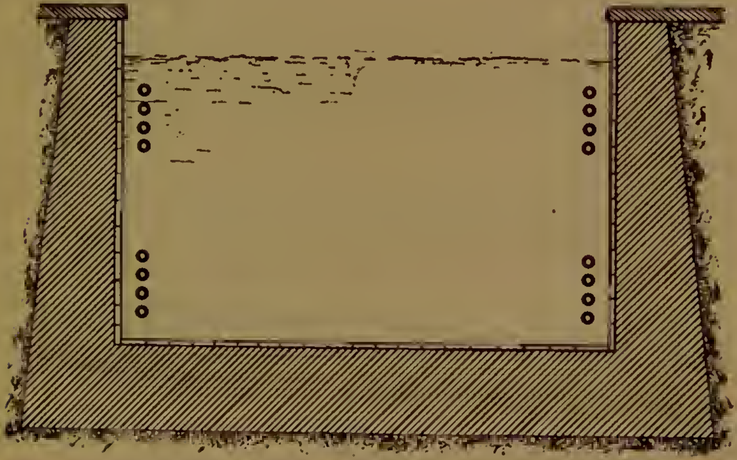


Fig. 18.

Heating by Submerged Coils. By far the poorest method of heating water in swimming pools is to have the heating coils located directly in the pool. It is unsanitary because it gives space for lodgment of foreign matter around and behind the pipes, and it is not desirable to have anything which can possibly be avoided obtruding into the pool. For a cheap construction it may be desirable to do this, and the method of doing it is shown in figures 18 and 19. In such an installation either live or exhaust steam is used to supply the coils. Figure 18 shows an end elevation of a swimming pool showing the position

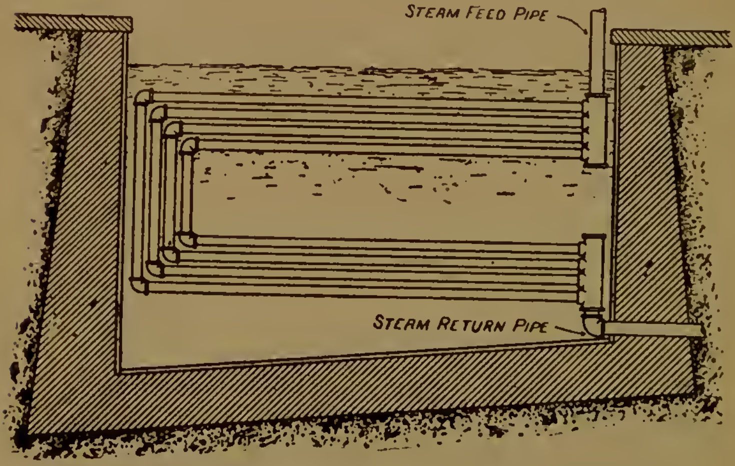


Fig. 19.

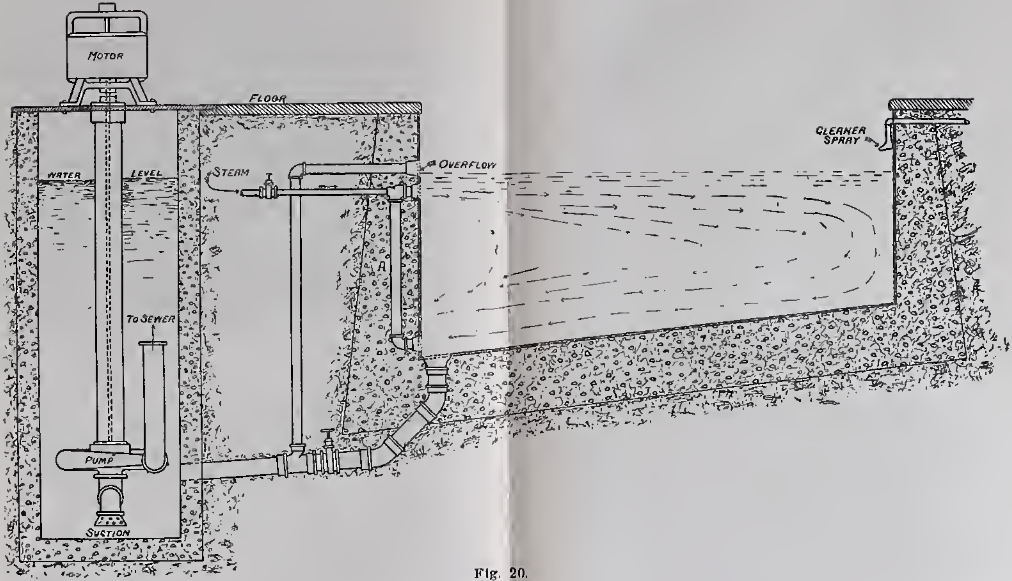

MOTOR
FLOOR
WATER LEVEL
STEAM
OVERFLOW
CLEANER SPRAY
A
TO SEWER
PUMP
SUCTION

Fig. 20.

of the steam coils at each side of the pool. Figure 19 is a side elevation showing the construction of the coils.

Heating by Injected Steam. Where live steam is available it may be used to warm the water by injecting it

(a) Into the water of the pool itself.

(b) Into the water just before it leaves the supply pipe at its entrance into the pool.

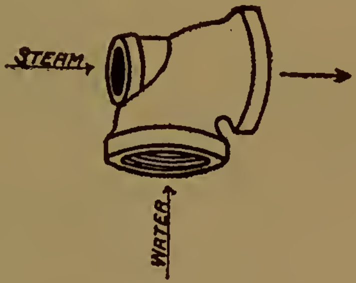


Fig. 21.

A simple form of this method of installation is shown in Figure 20, in which the pool is filled with cold water from the street main, the supply not showing in the illustration. The maximum depth of water carries the water line to an overflow placed above the inflow pipe. A circulation pipe "A" is taken from the bottom of the pool and carried up to the point where inflow is to be. By taking a 90° wrought iron elbow, with a 2″ heel opening, a mixing arrangement can be made as shown in Figure 21 which will introduce live steam into the water and form a syphon, the suction constantly drawing water from the bottom of the pool, warming it, and discharging it into the top of the pool. The steam pipe should have gate valve permitting the steam to be shut off when the water is warm enough or partially closed if its full capacity is not needed to maintain the temperature of the water.

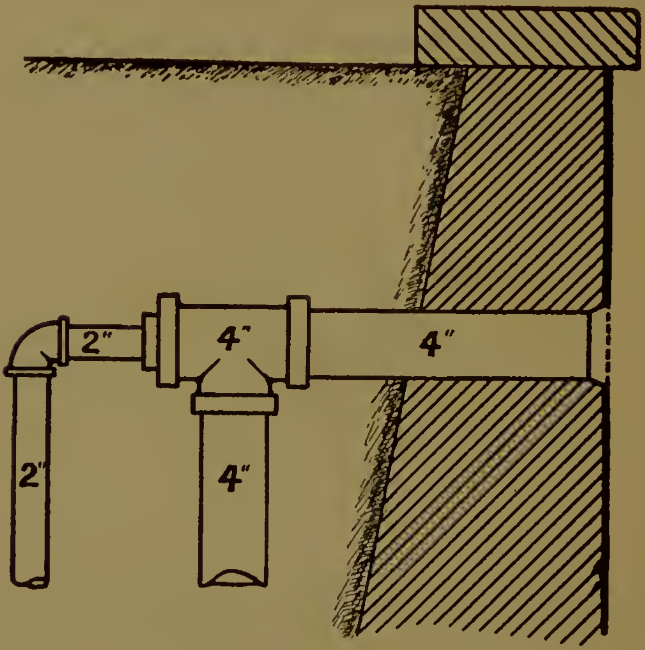


Fig. 22.

This method of installation maintains a constant current of water in the pool, which is highly desirable. Two spraying nozzles at the opposite end of the pool create a surface movement toward the overflow removing scum and floating matter. As the pool is below the sewer level the waste is by an open, unvalved pipe into a sump, in which is placed a submerged, eelctrically driven pump, with automatic control. The water stands in the sump on a level with the water in the pool, and any rise in the level automatically starts the pump. When it is desired to empty the pool the automatic control is removed and the pump discharges the contents of the pool into the sewer.

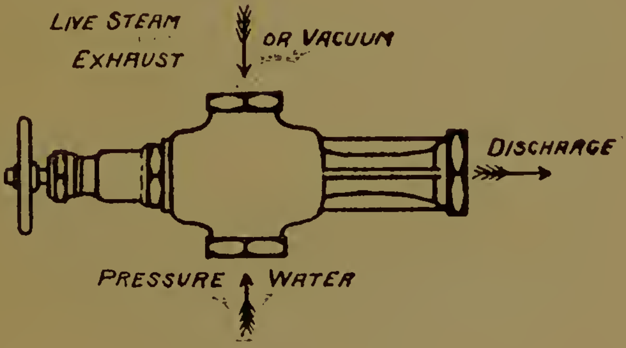


Fig. 23.

Another form of making the steam injector is shown in Figure 22, where a 4″ tee on the water main has one end reduced by a bushing and the 2″ steam main introduced into it. This is extremely simple and efficient.

A continuous water heater and steam ejector is shown in Figure 23. Live steam is introduced into the top and the water supply at the bottom, the heated water flowing out the lateral opening. It can be used with steam of any pressure or with exhaust steam.

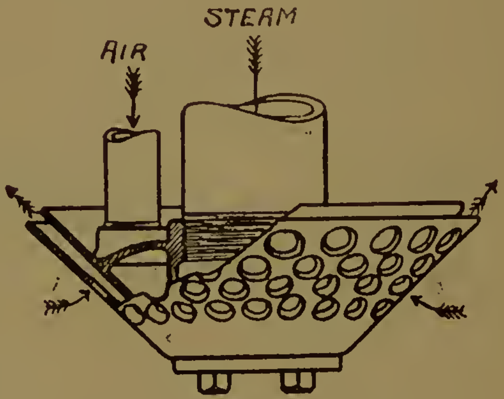


Fig. 24.

For the injection of steam at any pressure or exhaust steam directly into the water of the pool a device as shown in Figure 24 is used. It is claimed to be noiseless under any pressure. An air pipe introduces air into the water if desired, but its use is not necessary where only moderate temperatures are needed. Figure 25 shows the application of this device, a baffle plate assisting in creating a circulation in the pool.

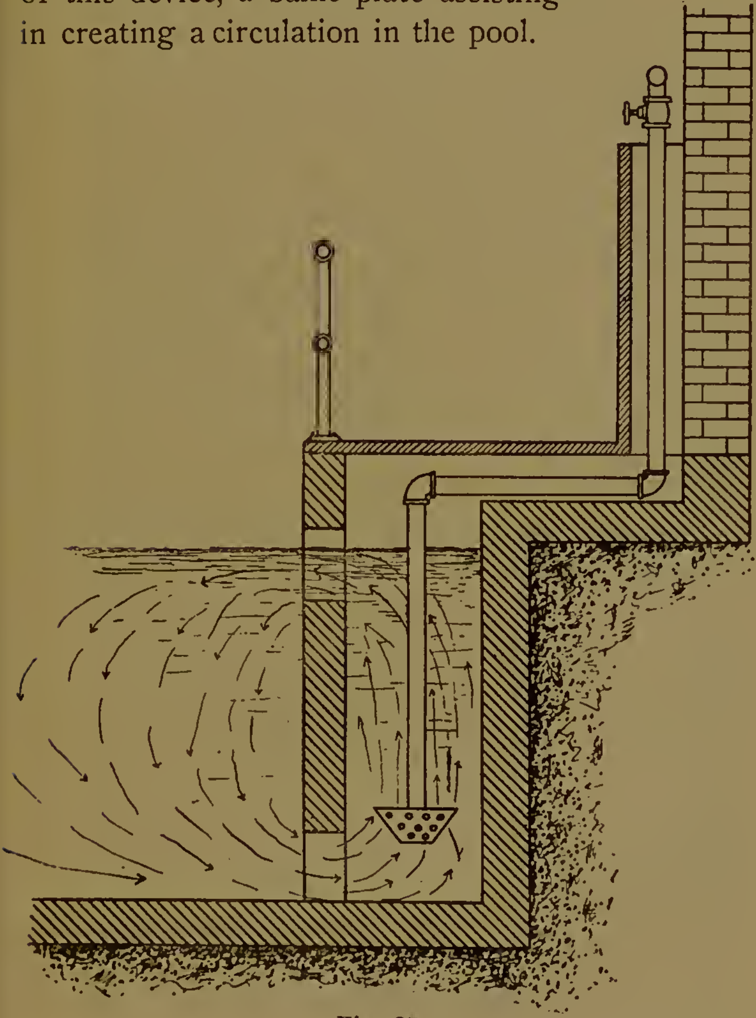


Fig. 25.

Heating by Live or Exhaust Steam. Figures 26 and 27 show another method of heating the water by a feed water heater or by the injection of live steam into the water. The cold water supply comes from filters and passes down to a three-way tee where it is carried to the right and left to vertical pipes which form the ends of a parallelogram. The cold water supply is admitted to the tank at two points, "A" and "B," and may be heated at these points by the introduction of steam which is conducted to the same opening by a 2″ steam pipe, cross connected, so that live or exhaust steam may be used. The cold water supply pipe is 5″, the right and left branches are 4″ and the vertical risers are 4″. Either cold or hot water may be introduced at the points "C" or "D"; the cold water is governed by a valve on the 4″ vertical pipe, and the hot water is governed by valves on the 3″ horizontal right and left branches. The hot water is supplied to the tank by a 4″ pipe cross-connected to feed water heaters. Figure 27 shows a section of the piping shown in elevation in figure 26. The waste is through an 8″ pipe, governed by a gate valve on the outside.

The overflow is from the shallow end of the pool and is not made in accordance with the best practice, which frowns upon any pipe obtruding into the pool. It is a standing overflow and the water level is governed by a slip pipe. A spraying nozzle at the end opposite the overflow, fed from the house tank, creates a surface flow which carries scum to the overflow end of the tank. Figure 7 shows the design of this spraying nozzle.

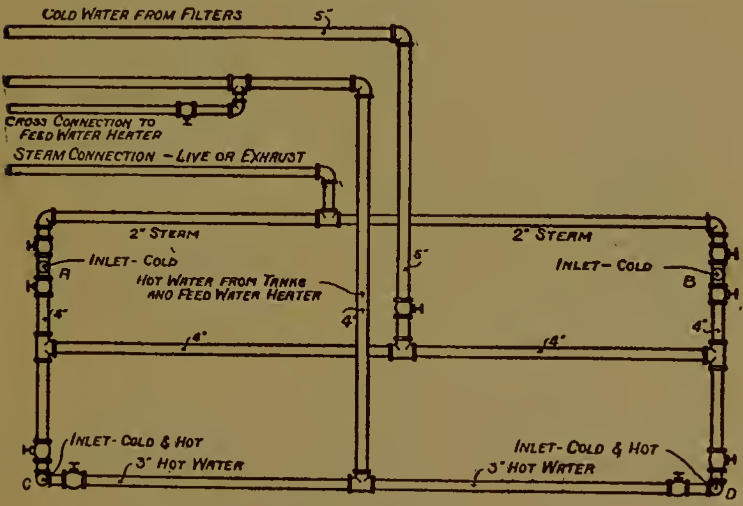


Fig. 26.

HEATING THE WATER.

The descriptions already given of various types of installation show that these methods are employed to heat water for swimming pools:

(a) *By submerged steam coils.*

(b) *By injection of live steam into the water.*

(c) *By live or exhaust steam in feed water heaters.*

(d) *By steam and hot water heaters in combination.*

(e) *By hot water heaters.*

(f) *By using water already warmed in other mechanical processes.*

The problem before the heating engineer is the determination of the heating power required for a pool of a given size, and the size of the apparatus necessary to generate or impart it.

These factors enter into the problem:

(a) The quantity of water to be heated.

(b) The time which may be consumed in the heating process.

(c) The number of degrees in temperature which the water must be raised.

For an illustrative problem a pool 50 feet long and 20 feet wide may be taken, the depth of water to be 2½ feet at the shallow end and 7½ feet at the deep end, or an average depth of 5 feet. The demands on the pool require that the water shall be heated in ten hours. The initial temperature of the cold water supply is 45° Fahr., and it is desired to maintain the pool at a temperature of 65°, so that the rise in temperature is 20 degrees. This temperature of 65° Fahr. is taken to make the problem a simple one. In actual practice the temperature of pools usually runs from 70° to 75° Fahr.

First. Determine the quantity of water to be heated.

50′x20′x5′ (average depth)=5,000 cubic feet.

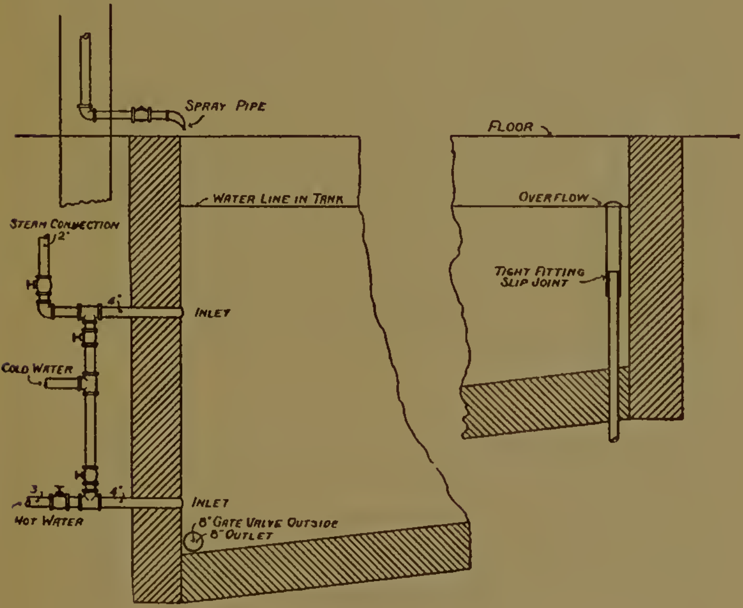


Fig. 27.

One cubic foot of water = 7.48 U. S. gallons; hence 5,000 cubic feet of water = 37,400 gallons.

One gallon of water weighs 8.33 pounds; hence 5,000 cubic feet of water = 37,400 gallons and weighs 311,542 pounds.

A British thermal unit (of which B. T. U. is the general abbreviation) is the quantity of heat required to raise one pound of water one degree of temperature. If the natural temperature of the cold water supply is 45° Fahr., and it is desired to have the water in the swimming pool at 65° Fahr., the temperature of the water must be raised 20 degrees. This will require a B. T. U. for each pound of water for each degree of the raise in temperature, or, for one degree, 311,542 B. T. U.; for 20 degrees raise it will require 311,542 × 20, or 6,230,840 B. T. U. If we can have 10 hours in which to heat the pool we must employ 6,230,840 ÷ 10, or 623,084 B. T. U. per hour, and an apparatus which will generate or impart that much heat must be installed.

Given the principle of the solution of the problem any other problem, involving varying quantities of the same factors, may be solved by it; and having found the number of B. T. U. required it must now be determined how to design different types of installation so that each may perform the required duty.

Observation shows that steam and hot water fitters whose experience has not required them to design or install heating plants for swimming pools, invariably think an apparatus will be large enough which, when installed, proves to be about one-third the required power. Hence a word of caution seems necessary.

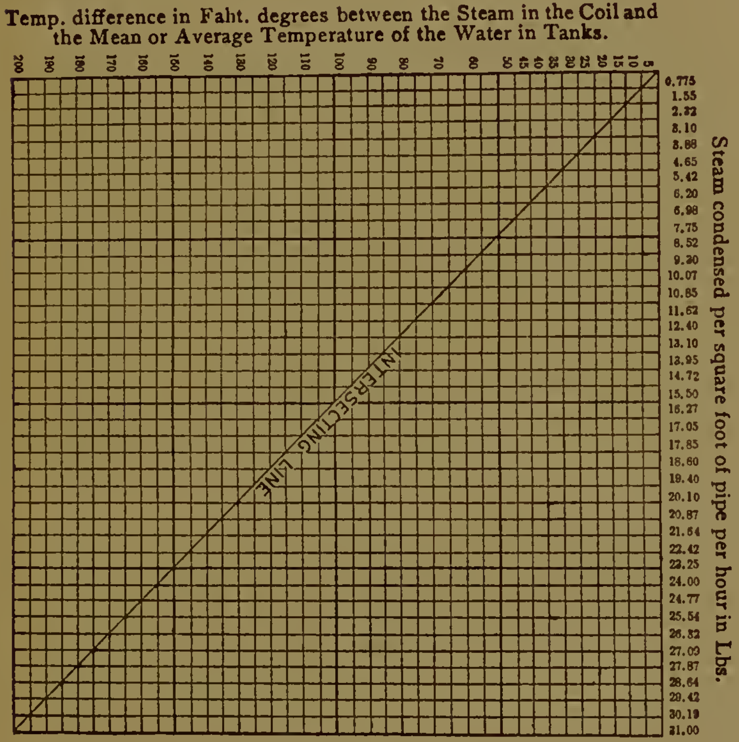


Fig. 28.

QUANTITY OF SUBMERGED COILS NECESSARY. Experiments have determined that one square foot of pipe, filled with steam and immersed in water, will condense 0.155 pounds of steam per hour for each Fahr. degree of difference between the temperature of steam and the mean temperature of the water.

The mean temperature of the water is 45° + 65° = 110° ÷ 2 = 55°. The temperature of steam at 1 lb. pressure above atmosphere is 215° Fahr.* The temperature difference between steam at one pound pressure of 215° and the mean temperature of the water, 55°, is 160°. By turning to figure 28, which is a "Chart to Find Steam Pipe Needed for Heating Water in Tanks," and which is copyrighted by The American Radiator Co., and reproduced from their "Ideal Fitter" for 1906 by permission, it is found that with 160° temperature difference 1 square foot of pipe will condense 24.77 pounds of steam per hour.

By turning to figure 29 (also reproduced from "The Ideal Fitter" by permission) it is found that the line representing 3,800 gallons of water intersects the line representing a temperature increase per hour of 20° at the vertical line indicating the consumption of 80 pounds of anthracite coal and a steam condensation of 688 pounds of steam.

---

*For temperatures of steam at other pressures see page 39 of "Notes on Heating and Ventilation," by Prof. John R. Allen. Published by "Domestic Engineering." $2.

As 37,400 gallons of water are to be warmed in 10 hours, 3,800 are to be warmed per hour.

As one square foot of pipe at the temperature difference of 160° condenses 24.77 pounds of steam, it is seen that

688÷24.77=27.5+square feet of pipe will be required.

One foot of 1″ pipe contains 0.34 square feet of surface;

27.5÷0.34=81 lineal feet.

One foot of 1½″ pipe contains 0.50 square feet of surface;

27.5÷0.50=55 lineal feet.

One foot of 2″ pipe contains 0.62 square feet of heating surface;

27.5÷0.62=44.5 lineal feet.

To these results there should be added 50 per cent to allow for incrustation of pipes with continued service.

Two-inch pipes, with an abundantly large steam feed pipe are recommended.

HEATING THE WATER BY HOT WATER HEATERS. Our previous computation showed that 623,084 B. T. U. per hour for 10 hours would be required to raise the temperature of water in the pool from 45 degrees to 65 degrees. The capacity of a hot water heater required for this duty may be arrived at as follows:

HEATING SURFACE REQUIRED.

Each square foot of heating surface in a small boiler will evaporate about 2 pounds of steam. As will be seen from the results above the steam condensed is 688 pounds per hour, so there will be required 344 feet of heating surface. For each square foot of heating surface we should have about one-twenty-fifth of a square foot of grate surface, so there will be required about 13 square feet of heating surface. For each square foot of grate surface in a small boiler there will be burned from 6 to 8 pounds of coal, which will correspond to an evaporation of 8 pounds of water, which is about right.

These conditions are seldom realized, and an allowance should be made for poor drafts and foul heating surface. Twenty or twenty-five per cent should be added, or 50 or 62½ feet, making the heating surface desirable about 300 or 312 square feet. Manufacturers of boilers usually rate the carrying capacity of their heaters at 10 square feet of radiation to 1 square foot of boiler heating surface, so that a heater with a rated capacity of 3,000 or 3,125 square feet of direct water radiation should be large enough to warm the water of a pool 20′x50′x5′ (average depth) from 45° to 65° in ten hours.

A USEFUL CHART.

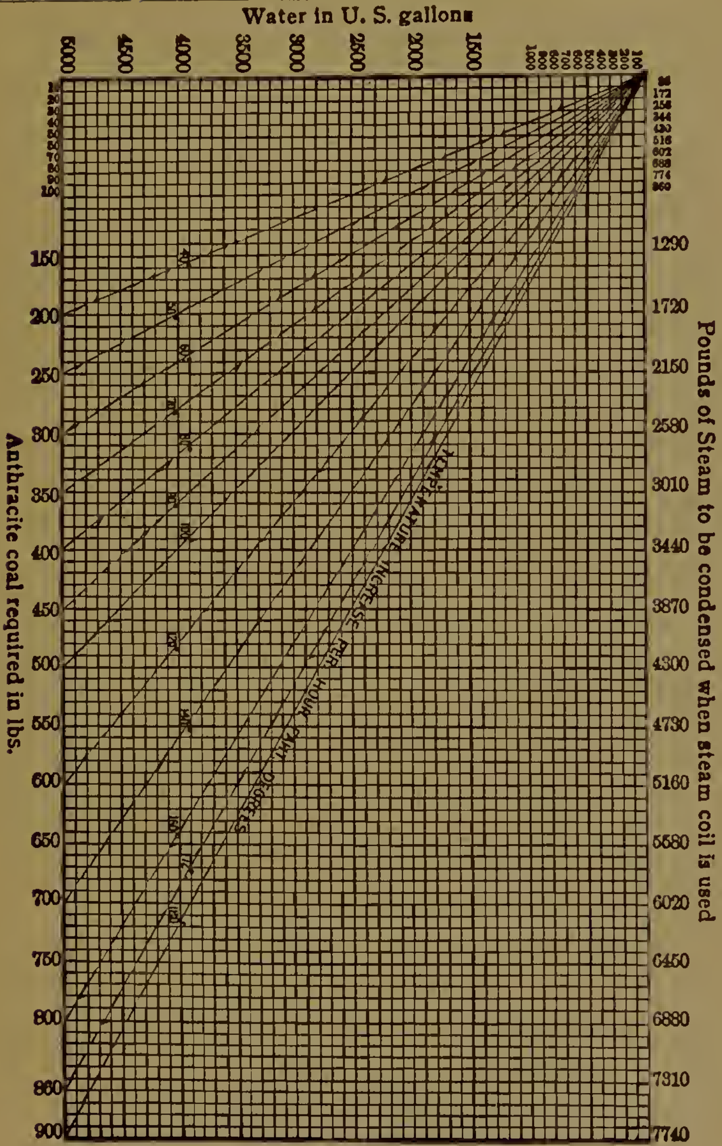


Chart "B"

Fig. 29.

The foregoing method fixes the size of the boiler by determining the heating surface required. As manufacturers usually rate boilers by grate surface, the following method may be used to find

Grate Surface Required. The tank referred to is 20′x50′x5′ (average depth) and contains 5,000 cubic feet. One cubic foot of water equals 7.48 gallons; 5,000 cubic feet of water equals 37,400 gallons, weighing 311,542 pounds. One pound of anthracite coal burned contains 8,333 B. T. U., and will evaporate 8.6 pounds of water. One square foot of grate will burn 8 pounds of anthracite coal per hour, and release 66,664 B. T. U. It requires one B. T. U. to raise one pound of water one degree of temperature, or 20 B. T. U. to raise one pound of water 20°. To raise 311,542 pounds 20° in one hour will require 6,230,840 B. T. U.; in ten hours, 623,084 per hour, which, divided by 68,664 (B. T. U. released by burning 8 pounds of coal on one square foot of grate surface in one hour) equals 90+sq. ft. of grate surface required to warm the tank full of water in ten hours.

ANOTHER METHOD OF DETERMINING GRATE SURFACE REQUIRED.

By reference to figure 28 it is found that the horizontal line marked 1,000 gallons intersects the 40° diagonal line at the 40-pound vertical line, showing that 40 pounds of anthracite coal are required to add 40° to 1,000 gallons of water. To add 40° to 37,400 gallons of water would require 1,496 pounds of coal; or to add 20° it would take 748 pounds. Having 10 hours to do the work we divide 748 by 10 and find we have to burn 74.8 pounds per hour. Eight pounds of coal is burned per hour on one square foot of grate surface, so $74.8 \div 8 = 9.4$ square feet of grate surface is the necessary quantity to which there should be added 25 per cent for foul heating surfaces.

Heating the Water by Feed Water Heaters. It may be taken as a basis for calculating the size of a feed water heater necessary to heat water for a swimming pool, that there will be a transmission of 200 B. T. U. per square foot of surface per hour per degree of difference between the mean temperature of the water and the temperature of the steam used to heat the water. The mean temperature of the water is 55° and the temperature of steam at atmospheric pressure is 212°, so that:

Each square foot of surface will transmit $212^\circ - 55^\circ = 157 \times 200$ B. T. U. = 31,400 B. T. U. per hour.

There are 311,542 pounds of water to be raised 20°, requiring 6,230,840 B. T. U. in one hour, or 623,084 per hour in ten hours.

$623{,}084 \div 31{,}400 = 19.8 +$ square feet of surface in the feed water heater.

The loss of heat by evaporation from the 1,000 square feet of surface of the pool will be considerable and imperfect circulation and foul heating surface will hinder results, so that 25 per cent additional heating surface should be provided, making, say, 24 or 25 square feet. In practice engineers add 5° to the final temperature, making it in the problem we have been utilizing 70° instead of 65°.

In the following formula this added temperature will be noted:

$$S = \frac{W \times D}{c(T-t)} = \frac{31{,}154 \times 25}{200 \times 155} = 25 + \text{sq. ft.}$$

S = Size of heater required.
W = Pounds of water per hour to be heated.
D = Temperature range.
c = Constant for copper coils.
T = Temperature of steam.
t = Mean temperature of water.

If live steam only is to be used in the feed water heater the table in Prof. John R. Allen's "Notes on Heating and Ventilation," page 39, will give the temperature of steam at any pressure. Say the pressure is 60 pounds. By the table we find the temperature of steam at that pressure is 307.1°. The last formula would then be stated thus:

$$S = \frac{W \times D}{c(T-t)} = \frac{31{,}154 \times 25}{200 \times 250} = 15 + \text{ sq. ft}$$

When a feed water heater is used for heating water in a swimming pool it is desirable that the

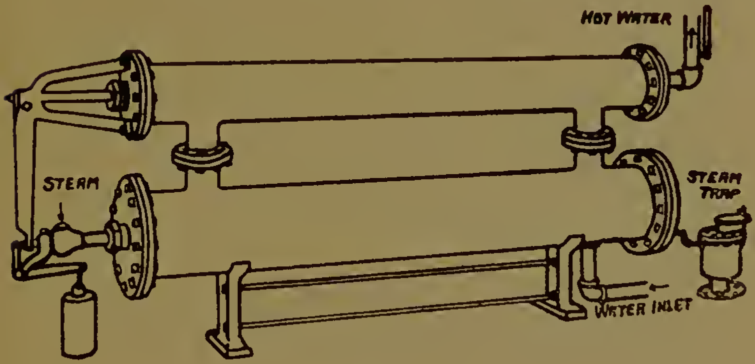


Fig. 30.

steam pass through the tubes and the water circulate through the shell. A thermostatic temperature regulating valve can then be installed which will maintain the water at a desired temperature.

Heating by Special Heaters. Figure 30 illustrates a special form of heater devised some years ago for heating water for baths, pools, etc., and used with success. It is composed of two horizontal cylinders from 6 to 8 feet long according to the size required. The upper cylinder contains a perforated copper tube, through which all the hot water passes. The hot water expands this copper tube which actuates a lever at the end of the heater and closes the valve when the water has reached the desired temperature. When the water cools the copper tube contracts, opening the valve for a new steam supply. The lower cylinder contains tubes which receive the steam and transmits its heat to the water flowing through the shell. It is made with capacities to raise from 1,000 to 10,000 gallons of water per hour from 50° to 150°. This type of heater works with high pressure, low pressure or exhaust steam.

HEATING BY INJECTED STEAM. Two methods are employed. The steam is either injected into the water before it reaches the pool, or it is injected directly into the pool. There is no difference in the number of heat units required and consequent consumption of coal; the injection of the steam into the water before it reaches the pool is by far the better method of installation, for two reasons, if for no others: injection of steam directly into the pool requires an obtruding object which should not be permitted; the introduction of steam at a high pressure directly into the pool causes noise and turbulence.

The injection of steam into the water as shown in figures 21 and 22 requires a determination of the heat units required, the consumption of steam taken from a plant possibly already overloaded, and the size of the steam feed pipe. In the problem under discussion we have already found 6,230,840 B. T. U. are required to heat the water of the pool. A pound of steam at 60 pounds pressure contains 1,175.6 heat units;

6,230,840 ÷ 1,175.6 = 5,300 pounds of steam required to be condensed to raise the temperature of the water 20 degrees in one hour. If there are ten hours available to heat the water 530 pounds of steam will be condensed per hour.*

The consumption of anthracite coal is arrived at by knowing that from the consumption of each pound of coal 8,333 B. T. U. are secured.

6,230,840 B. T. U. ÷ 8,333 = 747 + pounds of coal.

One pound of steam at 60 pounds pressure has a volume of 5.77 cubic feet; 530 pounds of steam would have a volume of 3,058.10 cubic feet, which would be the volume of steam to be conveyed per hour. Even in very large pipes the velocity of steam should not exceed 100 feet per second. The volume of steam, 3,058.10 cubic feet, to be transmitted in one hour, requires .849 cubic feet per second; a 2″ pipe has an area of 3.14 square inches; 3.14 ÷ 144 square inches = .0218 square foot; .849 ÷ .0218 = 38.9 feet per second. While, theoretically, the size of the pipe may be reduced below 2″ and the velocity increased, yet, practically, it is better to use a 2″ feed pipe and throttle it down to the desired degree; this for two reasons: first, it may be assumed that under certain circumstances it may be desired to heat the water in the pool in less than ten hours; second, it is desirable to have a pipe of a tangible size to prevent breakages and disarrangements which might happen if a pipe of the exact theoretical size were to be used.

---

*The number of heat units in one pound of steam at other pressures is shown on page 39 of Prof. John R. Allen's "Notes on Heating and Ventilation."

If the pool is to be heated by injection of steam directly into the pool, and the device shown in Figure 24 is used, the following table may be used to determine the size required:

Diam. of Steam Pipe.	Capacity in Heat Units Per Minute. Steam Pressure. 10 lbs.	20 lbs.	40 lbs.	60 lbs.	80 lbs.
¼	810	1,040	1,820	2,485	2,920
½	2,540	3,270	5,720	7,620	9,150
¾	4,375	5,625	9,845	13,125	15,750

Diam. of Steam Pipe.	Capacity in Heat Units Per Minute. Steam Pressure. 10 lbs.	20 lbs.	40 lbs.	60 lbs.	80 lbs.
1	7,000	9,000	15,750	21,000	25,200
1¼	11,500	15,000	27,000	35,000	42,000
1½	17,500	22,500	39,300	52,500	73,000
2	26,700	34,300	60,100	80,000	96,000
2½	39,000	50,500	88,500	108,000	141,500
3	61,200	78,750	137,500	183,700	215,500
4	103,250	132,750	231,200	309,759	371,700
6	245,000	315,000	550,000	735,000	862,000

As there are 6,230,840 B. T. U. required in 10 hours or 600 minutes, there will be 13,848 required per minute. The table shows that, at 60 pounds pressure, a steam pipe ¾″ in diameter would be required. Here as in the previous case, and for the same reasons, good practice would recommend a larger pipe.

Some Closing Don'ts.

Don't fail to have the walls of the pool water-tight.

Don't fail to have a pure and copious supply of filtered water.

Don't have any piping or other attachments obtruding into the pool below the water level.

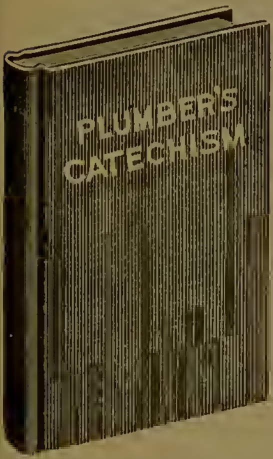
Don't fail to have ample supply of heat units available.

Don't fail to have a light and well ventilated room.

WELLCOME LIBRARY INSTITUTE

Plumbing Catechism

THEORY AND PRACTICE OF
PLUMBING DESIGN



By *Charles B. Ball,* M. Am. Soc. C. E., and M. Am. Soc. Inspectors of Plumbing and Sanitary Engineers, and *Herbert T. Sherriff, A. B.,* some-time Editor of "Domestic Engineering", M. Am. Soc. Inspectors of Plumbing and Sanitary Engineers.

Bound in cloth; 6¾ x 4¾; 100 pp; elaborately indexed.

This book formulates, in question and answer form, the basic principles of plumbing design and practice, crystallizing the knowledge of the skilled plumber, and providing the non-technical reader a source of information as free as possible from puzzling set phrases. It is sepecially commended to students in engineering and trade schools, and to master and journeymen plumbers, preparing for examinations. It does not discuss matters of handicraft such as joint wiping, lead burning, etc.

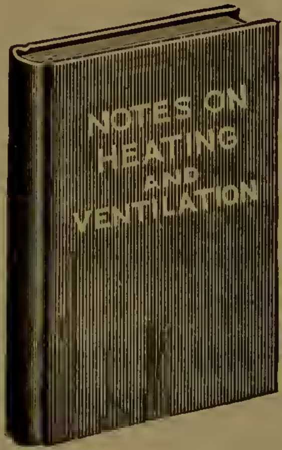
CONTENTS: PLUMBING FIXTURES: Lavatories, kitchen sinks, bath tubs, laundry tubs, slop sinks, urinals, water closets, water closet flushing apparatus, local ventilation, floor slabs, refrigerators. WATER SERVICE PIPES: Fixture supply pipes, storage tanks, hot water supply systems. THE DESIGN OF PIPE SYSTEMS: The main drain, the main trap, the air inlet, traps, ventilation pipes. PUMPS. EFFECTS OF FREEZING.

Price $1.00, delivered

DOMESTIC ENGINEERING
49-53 N. Jefferson Street, Chicago

NOTES ON

Heating and Ventilation



By *John R. Allen*, M. Am. Soc. Mech. Eng.; M. Am. Soc. Heating and Ventilating Eng.; Junior Professor Mechanical Engineering, University of Michigan, Ann Arbor.

Second Edition;
Bound in Cloth, 6¾ x 4¾ in;
200 pp.

This book is a resume of lectures delivered to classes in heating and ventilation at the University of Michigan. It is written primarily for the steamfitter and designer of heating systems. It presupposes a knowledge of the construction and operation of the simpler forms of heating systems. Reduced to as brief a form as possible, so that readers can readily find notes or data desired.

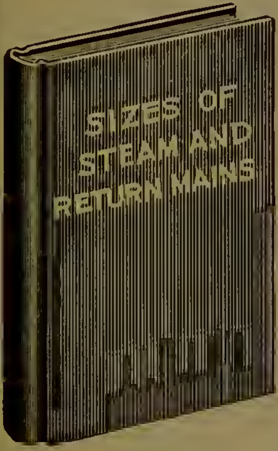
CONTENTS: Theory of heat and measurement of temperature. Heat losses from buildings; rules for determining heat loses in different constructions. Different forms of heating systems; their advantages, disadvantages and relative economy. The design of a direct steam heating system. The design of an indirect steam heating system. Steam boilers and steam piping. Determination of sizes and details of construction. Ventilation and the pollution of air by human beings; artificial lighting and chemical processes. Heating systems designed with reference to ventilation. Design of hot-air furnace and fan system of ventilation. Central station heating systems. Carrying pipes underground. Pipe coverings, etc. Sizes of risers and radiator connections, etc., etc.

Price $2.00, delivered

DOMESTIC ENGINEERING

49-53 N. Jefferson Street, Chicago

Sizes of Flow and Return Steam Mains



Being an apprentice's query as to correct sizes of pipes in heating plants, and answers thereto by twenty-five leading American heating engineers. These replies, giving the practice in some of the leading shops in many different cities of the country, with tables and diagrams, are by the following engineers:

Prof. R. C. Carpenter, Cornell University
Prof. J. H. Kinealy, St. Louis
John Gormly, Philadelphia
Ralph Collamore, Detroit
Gerard W. Stanton, New York
Wm. G. Snow, Boston
Thomas Barwick, New York
Ed. K. Munroe, Baltimore
W. R. Stockwell, Irvington-on-Hudson
Clarence M. Lyman, Utica, N. Y.
R. R. M. Carpenter, Wilmington, Del.
E. F. Capron, Chicago
J. R. Shanklin, Charleston, W. Va.
John S. Brennan, Milwaukee
H. A. Smith, New York
R. S. Thompson, Springfield, O.
Bernard Gause, Jacksonville, Ill.
J. J. Wilson, Philadelphia
Henry S. Kries, Baltimore
Reginald Pelham Bolton, New York
F. R. Still, Detroit
Thomas Morrin, San Francisco
James A. Donnelly, New York, and others.

Bound in Boards, 6¾ x 4¾ inches Price 50 cents, delivered

DOMESTIC ENGINEERING
49-53 N. Jefferson Street, Chicago

FIFTY
Plumbing Charts

Showimg how modern, up-to-date, sanitary plumbing should be done. Paper bound, 9x5¾ inches; 50 pp. A lay-out of each of the following jobs is shown, giving sizes of all pipes, heights of all fixtures; every joint, every piece of material and every fixture:

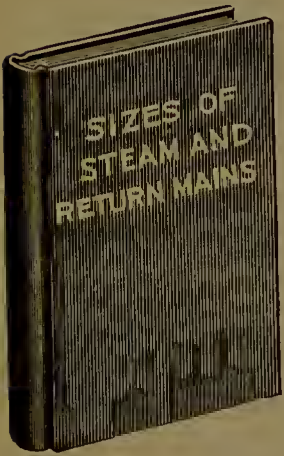
Plate 1 Kitchen Sink Connection
" 2 Lavatory "
" 3 Water Closet "
" 4 Bath Tub "
" 5 Wash Tray "
" 6 Pantry Sink "
" 7 Urinal "
" 8 Slop Sink "
" 9 Hotel Sink "
" 10 Sitz Bath "
" 11 Foot Bath "
" 12 Bath Room "
" 13 Refrigerator "
" 14 Refrigerator Line "
" 15 Ferrule Connections
" 16 Preparing Lead Works
" 17 Ferrule Connections
" 18 Cleanouts
" 19 Water Closets
" 20 Water Closets
" 21 Back Venting
" 22 Back Venting
" 23 Floor Con. for W. C.
" 24 Floor Con. for W. C.
" 25 Local Venting
" 26 Local Venting

Plate 27 Anti-Freezing W. C
" 28 Roof Connections
" 29 Roof Connections
" 30 Fresh Air Inlet
" 31 Fresh Air Inlet
" 32 Traps
" 33 Traps
" 34 Traps
" 35 Grease Traps
" 36 Soil Pipe on Side Wall
" 37 Plumbing for Residence
" 38 Cellar Work, Residence
" 39 Plumbing for Double House Under Test
" 40 Plumbing for 3 Tenement houses
" 41 Plumbing for Six Flats
" 42 Cellar Work for Stores and Flats
" 43 Plumbing for Horse Stall
" 44 Plumbing for Stables
" 45 Plumbing for Eng. House
" 46 Cellar Work, Eng. House
" 47 Plumbing for Hotel
" 48 Plumbing for R. R. Sta.
" 49 Plumbing for Y.M. C. A. Bldg.
" 50 Plumbing, High School

Price 25 cents, delivered

DOMESTIC ENGINEERING
49-53 N. Jefferson Street, Chicago

Sizes of Flow and Return Steam Mains



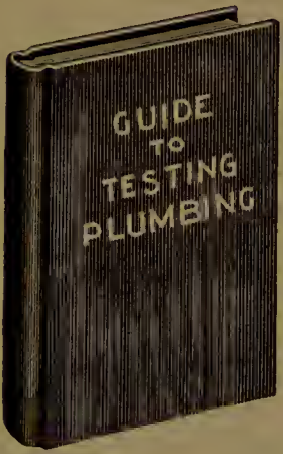
Being an apprentice's query as to correct sizes of pipes in heating plants, and answers thereto by twenty-five leading American heating engineers. These replies, giving the practice in some of the leading shops in many different cities of the country, with tables and diagrams, are by the following engineers:

Prof. R. C. Carpenter, Cornell University
Prof. J. H. Kinealy, St. Louis
John Gormly, Philadelphia
Ralph Collamore, Detroit
Gerard W. Stanton, New York
Wm. G. Snow, Boston
Thomas Barwick, New York
Ed. K. Munroe, Baltimore
W. R. Stockwell, Irvington-on-Hudson
Clarence M. Lyman, Utica, N. Y.
R. R. M. Carpenter, Wilmington, Del.
E. F. Capron, Chicago
J. R. Shanklin, Charleston, W. Va.
John S. Brennan, Milwaukee
H. A. Smith, New York
R. S. Thompson, Springfield, O.
Bernard Gause, Jacksonville, Ill.
J. J. Wilson, Philadelphia
Henry S. Kries, Baltimore
Reginald Pelham Bolton, New York
F. R. Still, Detroit
Thomas Morrin, San Francisco
James A. Donnelly, New York, and others.

Bound in Boards, 6¾ x 4¾ inches. Price 50 cents, delivered

Domestic Engineering, 49-53 N. Jefferson St., Chicago

A GUIDE TO
Testing Plumbing



By *Jno. K. Allen,* Member American Society of Inspectors of Plumbing and Sanitary Engineers. A full treatise showing the necessity of testing new and old work; 17 illustrations; paper bound.

CONTENTS

Why tests should be made. Inspection of material. Detecting imperfections. Usual tests. Closing the pipe. Makeshift closing devices. Testing earthenware drains.

Testing "roughing in". Applying the water test. Applying the air test.

Testing finished work. Applying the smoke test.

Testing old plumbing. Applying the peppermint test.

Testing gas piping.

Price 25 cents, delivered

Domestic Engineering, 49-53 N. Jefferson St., Chicago

FIFTY
Plumbing Charts

Showimg how modern, up-to-date, sanitary plumbing should be done. Paper bound, 9x5¾ inches; 50 pp. A lay-out of each of the following jobs is shown, giving sizes of all pipes, heights of all fixtures; every joint, every piece of material and every fixture:

Plate 1 Kitchen Sink Connection
" 2 Lavatory "
" 3 Water Closet "
" 4 Bath Tub "
" 5 Wash Tray "
" 6 Pantry Sink "
" 7 Urinal "
" 8 Slop Sink "
" 9 Hotel Sink "
" 10 Sitz Bath "
" 11 Foot Bath "
" 12 Bath Room "
" 13 Refrigerator "
" 14 Refrigerator Line "
" 15 Ferrule Connections
" 16 Preparing Lead Works
" 17 Ferrule Connections
" 18 Cleanouts
" 19 Water Closets
" 20 Water Closets
" 21 Back Venting
" 22 Back Venting
" 23 Floor Con. for W. C.
" 24 Floor Con. for W. C.
" 25 Local Venting
" 26 Local Venting

Plate 27 Anti-Freezing W. C
" 28 Roof Connections
" 29 Roof Connections
" 30 Fresh Air Inlet
" 31 Fresh Air Inlet
" 32 Traps
" 33 Traps
" 34 Traps
" 35 Grease Traps
" 36 Soil Pipe on Side Wall
" 37 Plumbing for Residence
" 38 Cellar Work, Residence
" 39 Plumbing for Double House Under Test
" 40 Plumbing for 3 Tenement houses
" 41 Plumbing for Six Flats
" 42 Cellar Work for Stores and Flats
" 43 Plumbing for Horse Stall
" 44 Plumbing for Stables
" 45 Plumbing for Eng. House
" 46 Cellar Work, Eng. House
" 47 Plumbing for Hotel
" 48 Plumbing for R. R. Sta.
" 49 Plumbing for Y.M. C. A. Bldg.
" 50 Plumbing, High School

Price 25 cents, delivered

Domestic Engineering, 49-53 N. Jefferson St., Chicago